Original instructions

OMRON

Type G9SE-201 Type G9SE-401
Type G9SE-221-T□

Safety Relay Unit

English

USER'S MANUAL

Thank you for purchasing G9SE Safety Relay Unit.
Please read and understand this manual before using the products.
Keep this manual ready to use whenever needed.
Only qualified person trained in professional electrical technique should handle G9SE.
Please consult your OMRON representative if you have any questions or comments.

OMRON Corporation 4022078-4 A

EU/EC Declaration of Conformity

OMRON declares that G9SE series are in conformity with the requirements of the following EU/EC Directives:
- EMC Directive: 2004/108/EC, 2014/30/EU
- Machinery Directive: 2006/42/EC

Standards

G9SE series are designed and manufactured in accordance with the following standards:
- EN ISO13849-1: 2008 PL e Category 4
- IEC/EN 60947-5-1,
- EN81-1
- UL508
- IEC/EN 62061 SIL3,
- EN81-2
- CAN/CSA C22.2 No.14

Precaution for Safe Use

Meanings of Signal Words
The following signal words are used in this manual.

⚠WARNING	Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or may result in serious injury or death. Additionally there may be significant property damage.

Meaning of Alert Symbols
The following alert symbols are used in this manual.

⃠	Indicates prohibited actions
❗	Indicates mandatory actions

Alert Statements

⚠ WARNING

Serious injury may possibly occur due to breakdown of safety outputs.
Do not connect loads beyond the rated value tothe safety outputs. ⃠

Serious injury may possibly occur due to loss of required safety functions.
Wire G9SE properly so that supply voltages or voltages for loads do NOT touch the safety inputs accidentally or unintentionally. ❗

Serious injury may possibly occur due to loss of safety functions.
Use appropriate devices referring to the information shown below. ❗

Controlling Devices	Requirements
Emergency stop switch	Use approved devices with Direct Opening Mechanism complying with IEC/EN 60947-5-1
Door interlocking switch Limit switch	Use approved devices with Direct Opening Mechanism complying with IEC/EN 60947-5-1 and capable of switching micro loads of 24VDC, 5mA.
Safety Sensor	Use approved devices complying with the relevant product standards, regulations and rules in the country where it is used.
Relay with forcibly guided contacts	Use approved devices with forcibly guided contacts complying with EN 50205. For feedback purpose use devices with contacts capable of switching micro loads of 24VDC, 5mA.
Contactor	Use contactors with forcibly guided mechanism to input the signal to Feedback/Reset input of G9SE through the NC contact of the contactor. For feedback purpose use devices with contacts capable of switching micro loads of 24VDC, 5mA. Failure to open contacts of a contactor cannot be detected by monitoring its auxiliary NC contact without forcibly guided mechanism.
Other devices	Evaluate whether devices used are appropriate to satisfy the requirements of safety category level.

Precautions for Safe Use

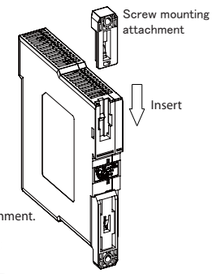
(1) Use G9SE within an enclosure with IP54 protection or higher of IEC/EN60529.
(2) When ready for wiring, the power source should be disconnected first. Further, at operating this unit, do not touch the terminals in order to prevent an electrical shock.
(3) Do not apply any excessive voltage or current to the input or output circuit the G9SE. Doing so may result in damage to the G9SE or cause a fire.
(4) Incorrect wiring may lead to loss of safety function. Wire conductors correctly and verify the operation of G9SE before commissioning the system in which G9SE is incorporated.
(5) Do not apply DC voltages exceeding the rated voltages, or AC voltages to G9SE.
(6) Use DC supply satisfying requirements below to prevent electric shock.
- DC power supply with double or reinforced insulation, for example, according to IED/EN60950 or EN50178 or a transformer according to IEC/EN61558.
- DC supply satisfies the requirement for class 2 circuits or isolated source with 4A current limit stated in UL 508.

(7) The lifetime of G9SE depends on the conditions of switching of its outputs. Be sure to conduct its test operation under actual operating conditions in advance and use it within appropriate switching cycles. Apply protection circuitry against back electromotive force in case connecting inductive loads to safety outputs.
(8) Do not operate the G9SE with flammable or explosive gas. An arc with operation and the heat of relay will cause a fire or an explosion.
(9) Do not drop G9SE to the ground or ,dismantle, repair, modify G9SE, otherwise an electric shock may occur or the G9SE may malfunction. It may lead to loss of its safety functions.
(10) Use protective device (Fuse etc.) for short-circuit protection and ground fault protection, otherwise a fire may occur or the G9SE may malfunction.
(11) Auxiliary monitoring outputs are NOT safety outputs. Do not use auxiliary outputs as any safety output. Such incorrect use causes loss of safety function of G9SE and its relevant system.
(12) After installation of G9SE, qualified personnel should confirm the installation, and should conduct test operations and maintenance.
The qualified personnel should be qualified and authorized to secure the safety on each phases of design, installation, running, maintenance and disposal of system.
(13) A person in charge, who is familiar to the machine in which G9SE is to be installed, should conduct and verify the installation.
(14) Perform daily and 6-month inspections for the G9SE. Otherwise, the system may fail to work properly, resulting in serious injury. Turn OFF the signal to Safety input and make sure G9SE operates without fault by checking the state of the LED indicator in inspection.
(15) Conformity to requirements of performance level is determined as an entire system. It is recommended to consult a certification body regarding assessment of conformity to the required safety level.
(16) OMRON shall not be responsible for conformity with any safety standards regarding to customer's entire system.
(17) Dispose of the Units according to local ordinances as they apply.

Precautions for Correct Use

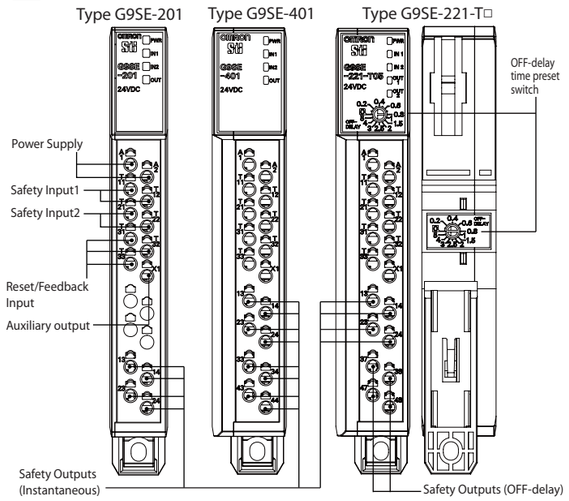
(1) Handle with care
Do not drop G9SE to the ground or expose to excessive vibration or mechanical shocks. G9SE may be damaged and may not function properly.
(2) Adhesion of solvent such as alcohol, thinner, trichloroethane or gasoline on the product should be avoided. Such solvents make the marking on G9SE illegible and cause deterioration of parts.
(3) Conditions of storage
Do not store in such conditions stated below.
1) In direct sunlight
2) At ambient temperatures out of the range of -10 to 55 ℃
3) At relative humidity out of the range of 25% to 85% or under such temperature change that causes condensation.
4) At atmospheric pressure out of the range 86 to 106 kPa.
5) In corrosive or combustible gases
6) With vibration or mechanical shocks out of the rated values.
7) Under splashing of water, oil, chemicals
8) In the atmosphere containing dust, saline or metal powder.
G9SE may be damaged and may not function properly.
(4) At least 50 mm above top face of G9SE and below bottom face of G9SE should be available to apply rated current to outputs of G9SE and for enough ventilation.
(5) Mounting multiple units
When mounting multiple units close to each other, the rated current will be 3 A. Do not apply a current higher than 3 A. If the output current is 3 A or more, make sure that there is a minimum distance of 10mm each between all adjacent G9SE units.
(6) DIN rail mounting
Mount G9SE to DIN rails with attachments (TYPE PFP-M, not incorporated to this product), not to drop out of rails by vibration etc. especially when the length of DIN railing is short compared to the widths of G9SE.
(7) Wire correctly according to 8 Wiring.
(8) Use cables with length less than 100 m to connect to Safety Inputs, Feed-back/Reset inputs, respectively.
(9) G9SE may malfunction due to electro-magnetic disturbances. Be sure to connect the negative terminal of DC power supply to ground. When using a DC power supply with light curtains, use DC power supply which has no interruption by a power failure of 20 ms.
(10) This is a class A product. In residential areas it may cause radio interference, in which case the user may be required to take adequate measures to reduce interference.
(11) Do NOT mix AC load and DC load to be switched in the following terminals.
- G9SE-201 : between 13-14 terminal and 23-24 terminal
- G9SE-401 : between 13-14 terminal and 23-24 terminal, 33-34 terminal and 43-44 terminal
- G9SE-221-T□ : between 13-14 terminal and 23-24 terminal, 37-38 terminal and 47-48 terminal

(12) Start entire system after more than 2s have passed since applying supply voltage to G9SE.
(13) Set the time duration of OFF-delay (Type G9SE-221-T□)
1) Set the time duration of OFF-delay to an appropriate value that does not cause the loss of safety function of system.
2) Set both of the two Off-delay Time Preset Switches, one each on the front and back, to the same value. When setting the different value, it is detected as a fault.
After setting, make sure G9SE operating time is correct.



(14) To determine safety distance to hazards, take into account the delay of Safety outputs caused by the following time:
1) Response time
2) Preset off-delay time and accuracy of off-delay time
(15) Before G9SE outputs become in ON-state, non-regular self-diagnosis for Safety output circuit may be executed.
On this occasion, the operating noise of internal relays occurs.
(16) In the place subjected to strong vibration or shock, mount G9SE to a mounting surface with screws and the screw mounting attachment. Otherwise, G9SE may not function properly due to vibration or mechanical shocks out of the rated values caused by sympathetic vibration of G9SE and the mounting parts, and so on.

1 Appearance and Explanation of Each Parts



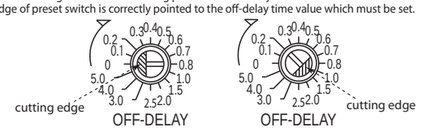
●LED Indicators

Marking	Color	Name	Function
PWR	Green	Power supply Indicator	Lights up while power is supplied. Blinks corresponding to the occurring error
IN1	Orange	Safety Input #1 indicator	Lights up while high signal is input to T12 Blinks when error relating to Safety input #1 occurs.
IN2	Orange	Safety Input #2 indicator	Lights up while high signal is input to T22 Blinks when error relating to Safety input #2 occurs.
OUT OUT1	Orange	Safety Output indicator	Lights up while Safety outputs (13-14, 23-24, 33-34, 43-44) are in ON-state. Blinks when an error relating to Safety output occurs.
OUT2	Orange	OFF-delayed Safety Output indicator	Lights up while off-delayed Safety outputs (37-38, 47-48) are in ON-state. Blinks when an error relating to Safety off-delayed solid-state output occurs.

●Preset Switches (only applies to Type G9SE-221-T□)
Change the value of the preset switches only when G9SE is disconnected from power supply.

Name	Function	Value
OFF-delayed time preset switch	Presets OFF-delay time (duplicate) (*1)	For Type G9SE-221-T05 0(default setting value)/0.1/0.2/0.3/0.4/0.5/0.6/0.7/0.8/1.0/1.5/2.0/2.5/3.0/4.0/5.0(s)(*2) For Type G9SE-221-T30 0(default setting value)/1/2/4/5/6/7/8/9/10/12/14/16/20/25/30(s)(*2)

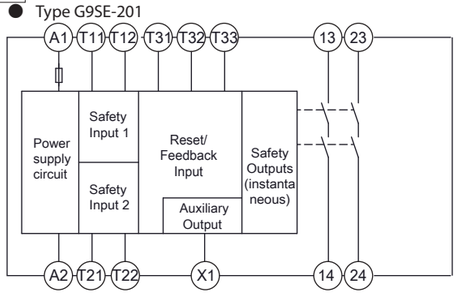
(*1) Set both of the two Off-delay Time Preset Switches, one each on the front and back, to the same value.
When setting the different value, it is detected as a fault.
(*2) See following illustration for setting position of Off-delay Time Preset Switch. Make sure that the direction of cutting edge of preset switch is correctly pointed to the off-delay time value which must be set.



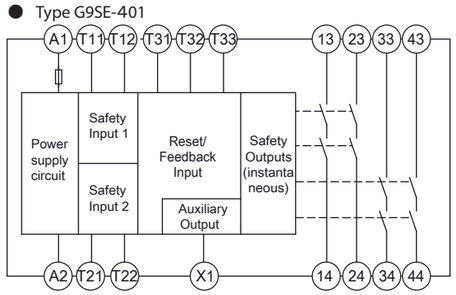
ex.1) 0 second off-delay setting ex.2) 1.5 second off-delay setting

2 Internal Connection

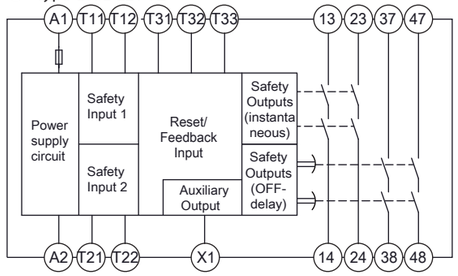
● Type G9SE-201



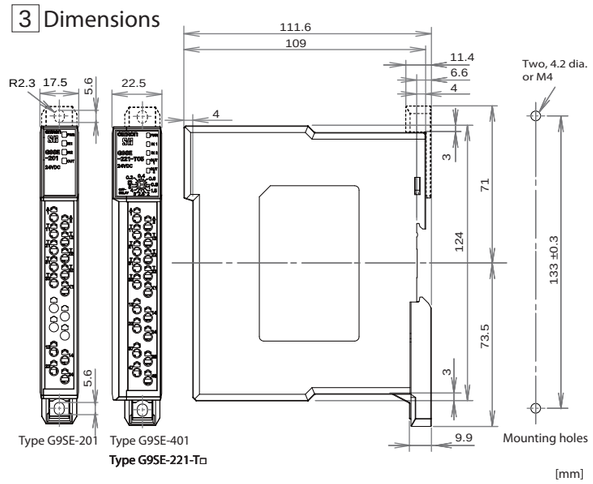
● Type G9SE-401


A1 T11 T12 T31 T32 T33 13 23 33 43
Power supply circuit
Safety Input 1
Safety Input 2
Reset/ Feedback Input
Auxiliary Output
Safety Outputs (instantaneous)
A2 T21 T22 X1 14 24 34 44

● Type G9SE-221-T□


A1 T11 T12 T31 T32 T33 13 23 37 47
Power supply circuit
Safety Input 1
Safety Input 2
Reset/ Feedback Input
Auxiliary Output
Safety Outputs (instantaneous)
Safety Outputs (OFF-delay)
A2 T21 T22 X1 14 24 38 48

3 Dimensions



4 Ratings and Specifications

●Ratings

Item		G9SE-201	G9SE-401	G9SE-221-T□
Power input	Rated supply voltage	24 VDC		
	Operating voltage range	-15% to 10% of rated supply voltage		
	Rated power consumption (See Note1)	3 W max.	4 W max.	4 W max.
Outputs	Safety output OFF-delayed Safety output	Contact output 250 VAC 5 A 30 VDC 5 A (resistance load)		
	Auxiliary output	PNP transistor output Load current : 100 mA DC max.		

●Specifications and performance

			G9SE-201	G9SE-401	G9SE-221-T□
Operating time (OFF to ON state) (See Note2)			100 ms Max. (See Note3)		
Response time (ON to OFF state) (See Note2)			15 ms Max.		
Accuracy of OFF-delay time			–	–	Within plus or minus 10% of the set value
Inputs	Input current		5 mA Min.		
	ON voltage		11 VDC Min.		
	OFF voltage		5 VDC Max.		
	OFF current		1 mA Max.		
	Maximum cable length		100 m Max.		
	Reset input time		250 ms Min.		
Contact outputs	Contact resistance (See Note4)		100 mΩ Max.		
	Mechanical durability		5,000,000 operations Min.		
	Electrical durability		50,000 operations Min.		
	Switching specification for Inductive load (IEC/EN60947-5-1)		AC15: 240 VAC 2 A DC13: 24 VDC 1.5 A		
	Minimum applicable load		24 VDC 4 mA		
	Conditional short-circuit current (IEC/EN60947-5-1)		100 A (See Note5)		
Pollution degree			2		
Over voltage category (IEC/EN60664-1)			Safety output: Class Ⅲ, the others: Class Ⅱ		
Insulation specification	Impulse withstand voltage (IEC/EN 60947-5-1)	Between input and output	6 kV		
		Between different poles of output	6 kV (between 13-14/23-24 and 33-34/43-44(37-38/47-48)) 4 kV (between 13-14 and 23-24, between 33-34(37-38) and 43-44(47-48))		
	Dielectric strength	Between input and output	2,200 VDC		
		Between different poles of output	1,500 VAC		
	Insulation resistance		100 MΩ Min.		
Vibration resistance (See Note6)			Frequency:10 to 55 to 10 Hz Amplitude:0.35 mm half amplitude (0.7 mm double amplitude)		
Mechanical shock resistance (See Note7)	Destruction		300 m/s^2		
	Malfunction		100 m/s^2		
Surrounding Air Temperature			-10 to 55℃ (No freezing or condensation)		
Ambient humidity			25% to 85%RH		
Degree of protection			IP20		
Weight			approx. 150 g	approx.180 g	approx.180 g

Note:
(1) Power consumption of loads not included .
(2) This does not include the bounce time of internal relay in the G9SE.
(3) This is in normal operation. When executing non-regular self-diagnosis for Safety output circuit, G9SE operating time become 500 ms max..
(4) This is initial value using the voltage-drop method with 1A at 5VDC.
(5) Use an 8A fuse that conforms to IEC 60127 as a short-circuit protection device. This fuse is not included with the G9SE.
(6) Condition: G9SE is mounted to mounting surface with screw and the screw mounting attachment. In the case of DIN rail mounting, mount DIN rail with G9SE to the place without big vibration. (Amplitude guideline: Less than 0.15 mm half amplitude (0.3 mm double amplitude))

Suitability for Use

Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases.
NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY OR IN LARGE QUANTITIES WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT(S) IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

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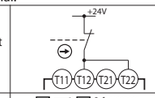
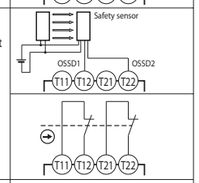
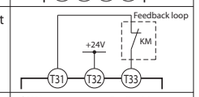
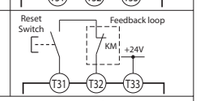
Note: Specifications subject to change without notice.

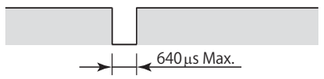
●Wiring of inputs and outputs

Signal Name	Terminal Name	Description of operation	Wiring
Power supply input	A1, A2	The input terminals for power supply. Connect the power source to the A1 and A2 terminals.	Connect the power supply plus to the A1 terminal. Connect the power supply minus to the A2 terminal.
Safety input 1	T11, T12	To set Safety outputs in ON state, HIGH state signals must be input to both of Safety input 1 and Safety input 2. Otherwise Safety outputs cannot be in ON state.	1-channel Safety input 
Safety input 2	T21, T22		2-channel Safety input 
Reset/ Feedback input	T31, T32, T33	To set Safety outputs in ON state, ON state signal must be input to T33. Otherwise Safety outputs cannot be in ON state.	Auto reset 
		To set Safety outputs in ON state, the signal input to T32 must change from OFF state to ON state, and then to OFF state. Otherwise Safety outputs cannot be in ON state.	Manual reset 
Safety output	13-14, 23-24, 33-34, 43-44,	Turns ON/OFF according to the state of safety inputs, Feedback/Reset inputs. During off-delay state, safety outputs are not able to turn ON.	Keep these outputs Open when NOT used.
Off-delayed Safety output	37-38, 47-48	Off-delayed safety outputs. (See Note1) Off-delay time is set by off-delay preset switch. When the delay time is set to zero, these outputs can be used as non-delay outputs.	Keep these outputs Open when NOT used.
Auxiliary output	X1	Outputs a signal of the same logic as Safety outputs	Keep these outputs Open when NOT used.

(1) When the inputs of G9SE-221-T□ are restored during off-delay time, G9SE-221-T□ will operate as below. Depending on the reset mode.
- Auto reset mode: Outputs turn off after off-delay time, then immediately turns on.
- Manual reset mode: Outputs turn off after off-delay time, then turn on when reset input is given.

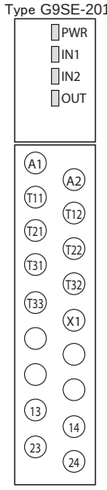
●Connecting Safety Sensors and G9SE

In many case, Safety Sensor outputs include the off-shot pulse for its self test.
The following condition of test pulse is applicable as safety inputs for G9SE.
- Off-shot pulse width of the sensor, during the ON-state : 640 μs

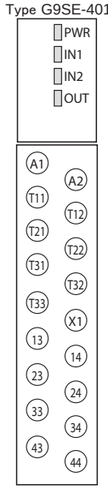


●Terminal arrangement and LED indicators

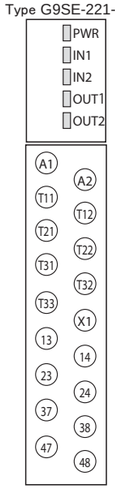
Type G9SE-201



Type G9SE-401

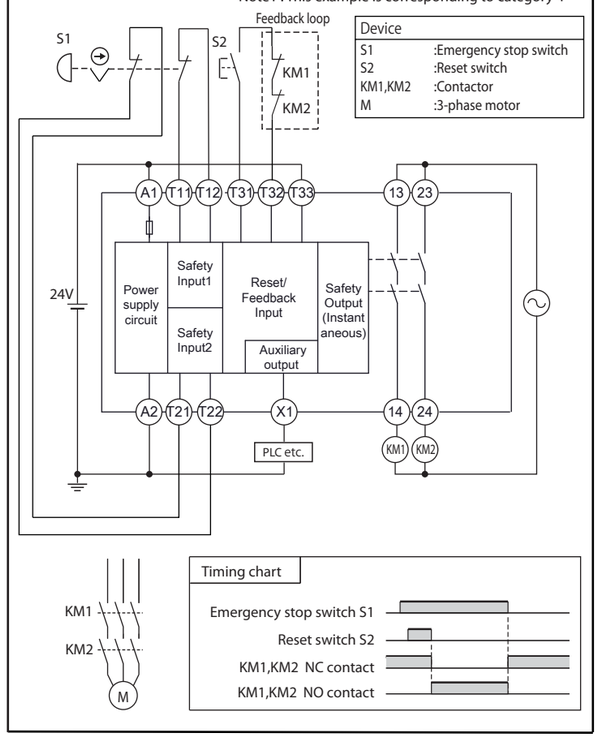


Type G9SE-221-T□

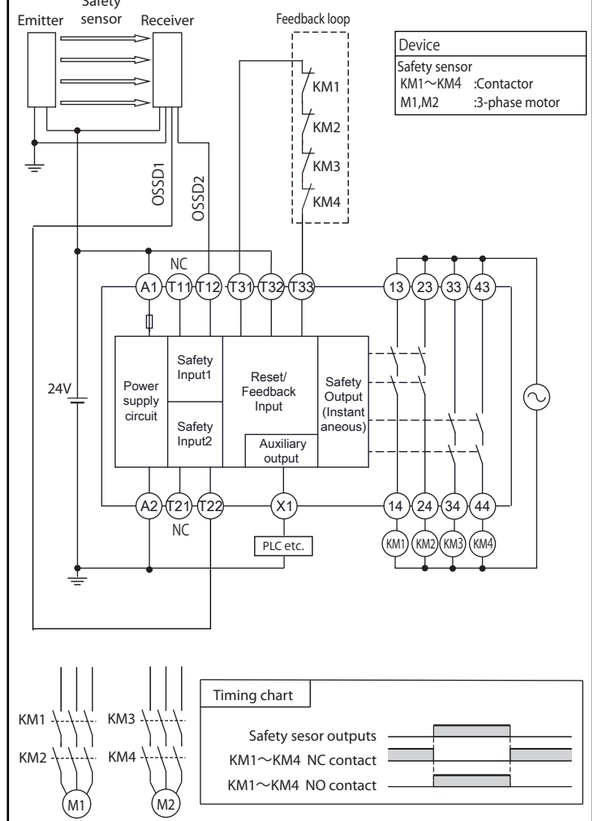


5 Examples of application

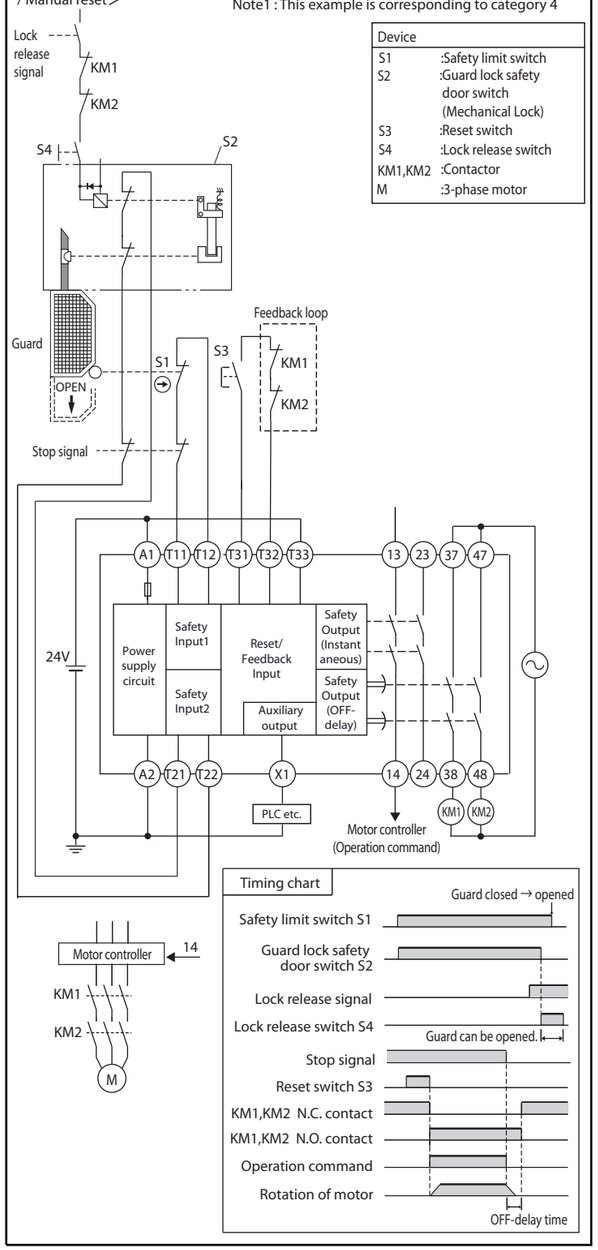
Type G9SE-201
＜2-channel emergency stop switch input / Manual reset＞
Note1 : This example is corresponding to category 4



Type G9SE-401
＜2-channel safety sensor / Auto reset＞
Note1 : This example is corresponding to category 4



Type G9SE-221-T□
＜Guard lock safety door switch (Mechanical Lock)・2-channel Safety limit switch inputs / Manual reset＞
Note1 : This example is corresponding to category 4



6 Performance level and safety category (EN ISO13849-1)

In the conditions shown in '5.Examples of Application' , G9SE can be used for the corresponding safety categories up to 4 and performance level(PL) up to e per ISO13849-1.
This does NOT mean that G9SE can always be used for the required category under all the similar conditions and situations.
Conformity to the categories must be assessed as a whole system.
When using G9SE for the safety categories, make sure the conformity of the whole system.
1) Input the signals to both of the Safety inputs (T12 and T22)
2) Input a signal to the Safety inputs (T11-T12 and T21-T22) through switches with Direct Opening Mechanism. When using limit switches, at least one of them must have Direct Opening Mechanism. And wiring must be done in a way that a short circuit between the wires of Safety input can be prevented.
3) When connecting a Safety sensor with G9SE, use a TYPE 4 safety sensor.
4) Input the signal through NC contacts of the contactors to Feedback/Reset input (T31-T32 for manual reset or T31-T33 for auto reset).(Refer to '5.Examples of Application'.)
5) Be sure to connect the negative terminal of DC power supply to ground.
6) Use two Safety outputs (e.g. 13-14 and 23-24) to construct the system.

7 Fault Detection

When G9SE detects a fault, LED indicators blink to show the information of the fault.

When PWR indicator blinks, check and take needed measures referring to the following table. And then apply supply voltage to G9SE.

LED indicator PWR	IN1	IN2	OUT OUT1	OUT2	Expected causes of the faults	Checking points and measures to take
Blink	Blink	—	—	—	1) Failures involving the wiring of Safety input 1 2) Failures of the parts of the circuits of Safety input 1.	1) Check the wiring to T11 and T12. 2) Replace with a new product.
	—	Blink	—	—	1) Failures involving the wiring of Safety input 2 2) Failures of the parts of the circuits of Safety input 2.	1) Check the wiring to T21 and T22. 2) Replace with a new product.
	Safety inputs: ON-state Light up	Light up	—	—	1) Failures involving the wiring of Feedback/Reset input. 2) Failures of the parts of the circuits of Feedback/Reset input.	1) Check the wiring to T31, T32, and T33 2) Replace with a new product.
	Safety inputs: OFF-state Light off	Light off	—	—		
	—	—	Blink	Blink	1) Failures of the parts or relays of the circuits of Safety Output.	1) Replace with a new product.
	—	—	—	Blink	1) Mismatch of the two Off-delay Time Preset Switches.	1) Check both of the two Off-delay Time Preset Switches.
	The all indicators Blink				1) Supply voltage outside the rated value.	1) Check the supply voltage to G9SE.
	The all indicators Light off				1) By excessive electro-magnetic disturbance. 2) Failures of the parts of internal circuits	1) Check the disturbance level around G9SE and its related system. 2) Replace with a new product.

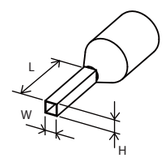
When indicators other than PWR indicator blink while PWR indicator lights up, check and take needed measures referring to the following table. After removing the fault, turn both safety inputs to OFF state.

LED indicator PWR	IN1	IN2	OUT OUT1	OUT2	Expected causes of the faults	Checking points and measures to take
Light up	Safety inputs: ON-state Blink Blink Light off	Blink Light off Blink	—	—	1) Mismatch between Safety input 1 and Safety input 2. (OFF timing)	1) Check the wiring from safety input devices to G9SE. Or check the inputs sequence of safety input devices.

8 Wiring

Use the following to wire to G9SE.
- Solid wire: AWG24 to AWG16 (0.25 to 1.5 mm²)
- Stranded wire: AWG24 to AWG16 (0.25 to 1.5 mm²)
Strip the cover of wire no longer than 8 to 10 mm
When using stranded wire, insulated ferrule should be used. Use below insulated ferrule.
But do not use ferrule terminals if G9SE is used as UL Listing. Insert the strand or solid wire directly into the holes on the terminal block.
- Insulated ferrule: AWG24 to AWG16 (0.25 to 1.5 mm²)
- Crimp height(H): 2.0 mm max. Width(W): 2.7 mm max. Conductor length: 8 to 10 mm
When using the twin type ferrule, use equal-sized wires and preferred insulated ferrule.
The twin type ferrule should not be above the adjoining release hole.

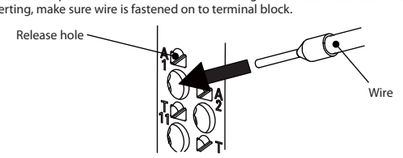
■Recommended insulated ferrule: manufactured by Phoenix contact



Type		Wire size Cross section(mm²)	AWG
Single	AI 0,34-8TQ	0,34	22
	AI 0,5-10WH	0,5	20
	AI 0,75-10GY	0,75	18
	AI 1-10RD	1,0	18
	AI 1.5-10BK	1,5	16
Twin	AI TWIN2x0.75-10GY	2 x 0.75	—

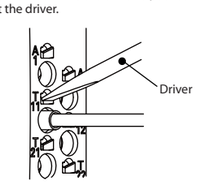
●How to insert solid wire and insulated ferrule

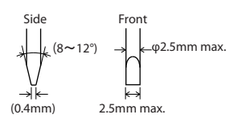
The wire should be pushed into the terminal block straight. No need to use the driver.
After inserting, make sure wire is fastened on to terminal block.



●How to release wire

Use the following minus drive to release wire from terminal block.
And When releasing wire, the power source should be disconnected first.
1. Push the driver lightly into the taper of release hole.
2. Pull out the wire while the driver is pushed into release hole.
3. Pull out the driver.





Recommended driver:
Type SZF0-0.4mmx2.5mm
manufactured by Phoenix contact
Type XW4Z-00B manufactured by Omron

●Precautions for Correct wiring

Terminal block may be damaged.
1. Not push the driver into the release hole straight.
2. Not push the driver into the release hole by force of 30N and over.
3. Not tip or twist the driver pushed into release hole.